LOS ANGELES COUNTY MUSEUM OF NATURAL HISTORY FOUNDATION

(In Cooperation with the Marineland Research Laboratory)

Technical Report Number 9

Submitted to the Office of Naval Research under

Contract Number N00014-67-C-0358

and subsequent

Modification Numbers P001 and P002

STATISTICAL EVIDENCE FOR INDIVIDUAL SIGNATURE WHISTLES IN THE PACIFIC WHITESIDED DOLPHIN, *LAGENORHYNCHUS OBLIQUIDENS*

MELBA C. CALDWELL AND DAVID K. CALDWELL

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LOS ANGELES, CALIFORNIA

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ABSTRACT: The whistles of three Pacific whitesided dolphins were analysed for signature content. While the whistles of these animals were the least stereotyped of any species studied in this regard to date, the hypothesis of a signature whistle in certain species of dolphins (if not all that whistle) was found to hold. Only two of the animals studied made enough whistles definitely attributable to the individual to make definitive statements. The few whistles surely emitted by the third animal corroborated the other findings that such a signature whistle exists in this species. The whistle type of sound in one of the individuals studied seemed to grade into a pulsed type of sound referred to in earlier literature as a tin horn sound. Numerous sound spectrograms are used to illustrate the discussion.

STATISTICAL EVIDENCE FOR INDIVIDUAL SIGNATURE WHISTLES IN PACIFIC WHITESIDED DOLPHINS, LAGENORHYNCHUS OBLIQUIDENS

Melba C. Caldwell[1] and David K. Caldwell[2]

INTRODUCTION

The Pacific whitesided dolphin, Lagenorhynchus obliquidens (see Fig. 1), is one of the odontocete cetaceans which emits whistles. Beyond a statement to this effect (Evans, 1967: table 1), no studies of these are available. There are no published sound spectrograms of the whistles of this species although there are for other members of the genus (see, for example, Schevill and Watkins, 1962; Tavolga, 1965, 1968).

METHODS

The subject animals were recorded both by hydrophone in water and by microphone in air under a wide variety of conditions. Whistles first were analysed by ear at 1/8 recorded speed and then gross visual sound spectrograms were run on an acoustic analyser giving only a picture of the contour rather than a detailed analysis of its content. These sounds were then spot checked using a more detailed form of sound spectrogram.

Durations were calculated at 1/8 recorded tape speed and reconverted to real time. This method checked reliably to 0.1 second against the wide band spectrograms made on the Kay machine (see below).

EQUIPMENT

Sounds were recorded using Uher Report recorders (generally a Report-S or a Report-L) which at a tape speed of 19 cm (7.5 inches) per second have a rated frequency response of from 40 Hz to 20 kHz. Hydrophone recordings were made using an Atlantic Research Corporation model LC-57 hydrophone with a special preamplifier designed and built for the system by William W. Sutherland of the Lockheed California Company. A compatable Uher microphone was used for the air recordings. Sound spectrograms (Sonagrams) were made on a Kay Sonagraph model 662A Sound Sprectrum Analyzer calibrated in two sections from 85 Hz to 12 kHz. When the recorded tape speed is reduced by half and then fed into the analyzer, the frequency response of the latter is doubled. Other spectrographic checks were made using a Listening, Inc. MSA-1 Spectrum Analyzer.

RECORDING SITES

Two of the dolphins were recorded as members of a community held at Marineland of the Pacific near Los Angeles, California. Details of this community tank situation may be found in Caldwell and Caldwell (1967). The third animal was recorded at Marineland of Florida near St. Augustine. The latter animal lived part of the time in a community tank and the rest of the time in a small holding tank. In all cases, he was with delphinids of other genera, but the recordings for the most part were made under conditions out of water when we were sure he was the animal whistling. Those at Marineland of the Pacific were either recorded under these conditions, or when the whistling animal could positively be identified by concurrent emission of air from the blowhole.

SUBJECT ANIMALS

All three individuals were captured off the California coast in the vicinity of Los Angeles. Their descriptions follow:

Animal number 1

Marineland of the Pacific, no number available. Female of adult size, 175.0 cm in length from tip of upper jaw to fluke notch. No formal name, but identified on recorded tapes and in notes as "Marked Lag". Recorded during a 17-month period from September 30, 1965, through March 18, 1967. Whistles analysed from the hydrophone recordings (Table 1) were confined to those specifically called on the tapes as being emitted by this animal.

Animal number 2

Marineland of Florida animal number 193. Male, adult, 189.5 cm in length. Named "Blaze". Captured on November 4, 1966, and flown to Florida in early 1967. Recorded during a 20-month period from September 14, 1967, through February 12, 1969. Recording dates and conditions of recording are listed in Table 1.

Animal number 3

Marineland of the Pacific, no number available. Female of adult size, 185.5 cm in length. No formal name, but identified on recorded tapes and in notes as "Unmarked Lag". Recording dates and conditions duplicated those of Animal Number 1.

ANALYSIS

For the most part, we could not classify the whistles of these three animals in the same manner that we have classified those of most Atlantic bottlenosed dolphins (Tursiops truncatus), eastern Pacific common dolphins (Delphinus delphis bairdi), and to a lesser degree, spotted dolphins (Stenella plagiodon). In opposition to these latter species, the whistles of the Pacific whitesided dolphin contain too much variability within the individual and too little variability between individuals to classify them reliably to individual from recordings of groups containing several animals. Two of the three could not be classified by subgroups of numbers of loops or other easily quantifiable units.

The above statements are most subject to demonstration by the use of sound spectrograms, but the limitations of this method of presenting sound should be kept in mind.

RESULTS OF ANALYSIS

Animal number 1

This was a vocal animal. Even those tape recordings made in a community tank with another of the same species and several Atlantic bottlenosed dolphins contain many whistles specifically attributed to it. It also vocalized in air, allowing for comparisons of whistles made in both media. Those vocalizations shown in Figures 2 through 8 were emitted in air while the animal was stranded; those shown in Figures 9 through 12 were emitted in water. None had the well defined sound loops, either to the ear or on sound spectrograms, as do those of most bottlenosed dolphins, or even Animal Number 2 below.

Durations of those emitted in water (N = 48) ranged from 0.3 to 0.8 seconds and averaged 0.5 seconds.

The whistles shown in Figures 13 and 14 exhibit a large degree of tremulousness; they were emitted in air during venipuncture. Attention is called to the similarity between the tremulo in these figures and that of a whistle of a common dolphin (Delphinus delphis) depicted by Busnel and Dziedzic (1966: fig. 38) as an example of what they record routinely during capture attempts (op. cit.: 632 f.). This tremulo has been found as well in some of the whistles emitted by a spotted dolphin when it was stranded and handled (Caldwell, Caldwell and Miller, 1970).

Animal number 2

The whistles of this animal were more constant than those of the others and the number of loops and partial loops could be approximated with some degree of accuracy.

The figured sound spectrograms were all taken from whistles emitted during recording sessions when the animal was being moved or given routine physical examinations. The latter frequently included administration of medication and venipuncture. Figures 15 through 25 indicate the degree of consistency versus inconsistency in his whistles. Figure 25 illustrates an aberrant whistle.

Durations of whistles ranged from 0.2 to 1.2 seconds; the average duration was 0.7 seconds (N = 34).

As they demonstrated loops, they were grouped by numbers of each type and the percentage of each appear in Table 2.

Whistles of two, three, and four loops constituted the majority of the whistles and would appear to represent the mode for this animal.

Animal number 3

This animal did not whistle in air. In water it almost never emitted whistles while simultaneously emitting streams of air bubbles from its blowhole. As this is the only way that specific whistles could be attributed positively to a specific individual, there are insufficient data to present an analysis. Figures 26 and 27 are representative of two of its whistles. Durations are 0.6 and 0.7 seconds each, making them roughly equivalent to most of those emitted by Animal Number 1. The division of sound into two components appeared a normal characteristic of this animal's whistle.

DISCUSSION

The whistles of these three individuals were the least stereotyped of those of any of the other species of dolphins that we have examined closely to date (see species noted above). More stereotypy was evidenced in the "tin horn" sound emitted by two of the Pacific whitesided dolphins (Animals Number 1 and 3) (see Caldwell and Caldwell, 1967) than in their whistles. A sound intermediate between the whistle and tin horn also occurred. This progression in the same individual is shown in Figures 28 through 30. Figure 28 is a tin horn sound, Figure 29 sounds to the ear as intermediate between a tin horn and a whistle, and Figure 30 sounds like a clear whistle.

ACKNOWLEDGMENTS

Financial support for various phases of this study came from the Office of Naval Research (contract no. N00014-67-C-0358, and modifications P001 and P002, with the Los Angeles County Museum of Natural History Foundation in cooperation with the Marineland Research Laboratory), the National Science Foundation (grant no. GB-1189), the National Institute of Mental Health (grant no. MH-07509-01), and Marineland, Inc. Special thanks are due John H. Prescott of Marineland of the Pacific for permission to record the two animals under his charge, as did David H. Brown before he departed Marineland. The photographs appearing as Figures 2 through 30 are by Natcher R. Fain, Marineland of Florida.

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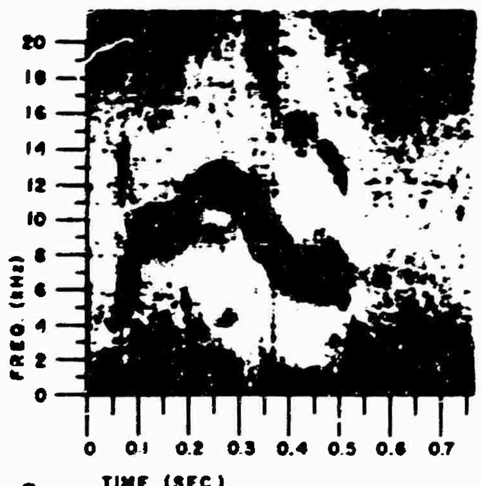
Figure 1. Adult-sized female Pacific whitesided dolphins, Lagenorhynchus obliquidens, captive at Marineland of the Pacific. Left: Animal Number 3 ("Unmarked Lag"); Right: Animal Number 1 ("Marked Lag"). (Photograph by David K. Caldwell, reproduced with the cooperation of Marineland of Florida.)

1

Figures 2 – 8. Sound spectrograms of whistle emissions by an adult-sized female Pacific whitesided dolphin (Animal Number 1) captive at Marineland of the Pacific. Sounds recorded in air while the animal was stranded during venipuncture. Effective filter bandwidth in each case 600 Hz. (Photographs courtesy Marineland of Florida)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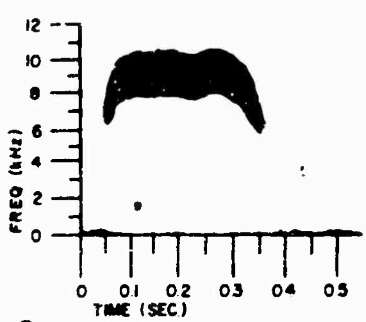
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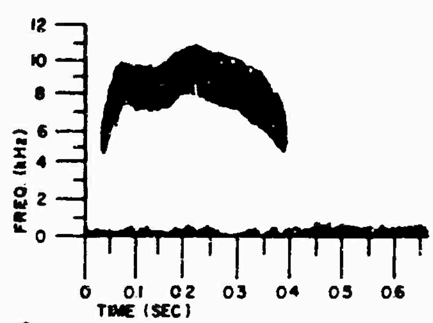
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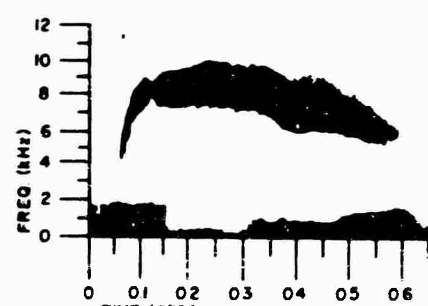
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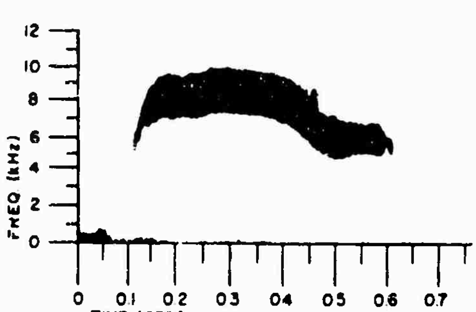
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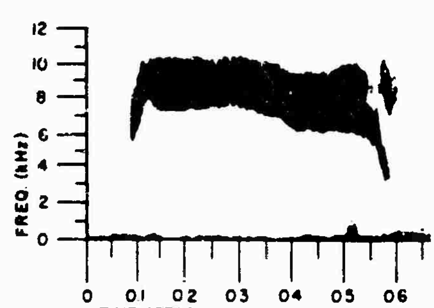
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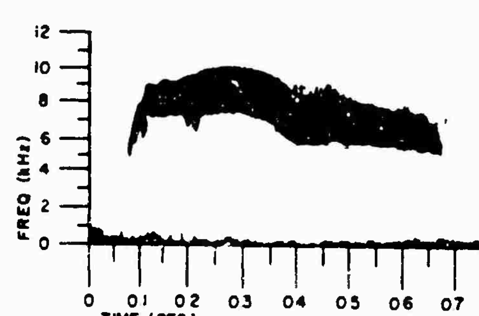
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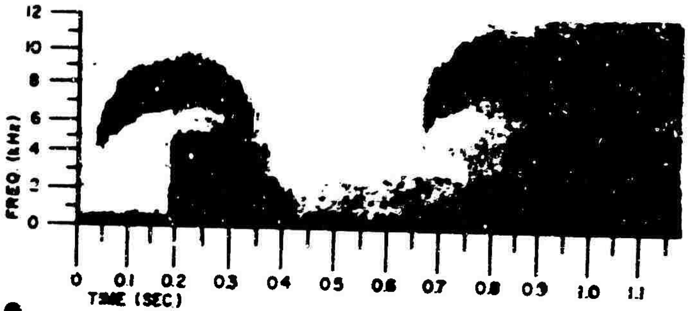
Figures 9 – 12. Sound spectrograms of whistle emissions by an adult-sized female Pacific whitesided dolphin (Animal Number 1) captive at Marineland of the Pacific. Sounds recorded in water under normative conditions. Effective filter bandwidth in each case 600 Hz. (Photographs courtesy Marineland of Florida)

Figures 13 – 14. Sound spectrograms of whistle emissions by an adult-sized female Pacific whitesided dolphin (Animal Number 1) captive at Marineland of the Pacific. Sounds recorded in air while the animal was stranded during venipuncture. Note tremulous quality of emissions. Effective filter bandwidth in each case 600 Hz. (Photographs courtesy Marineland of Florida)



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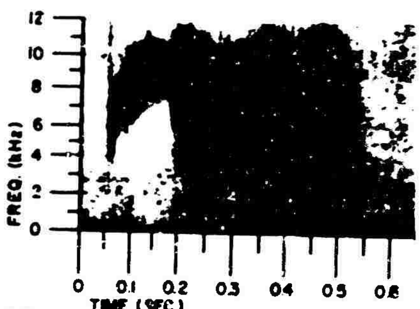

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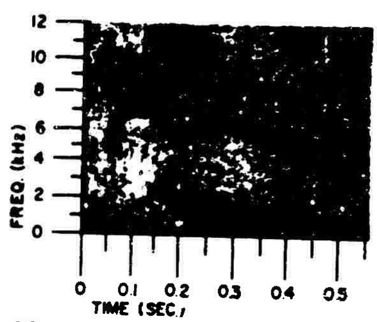

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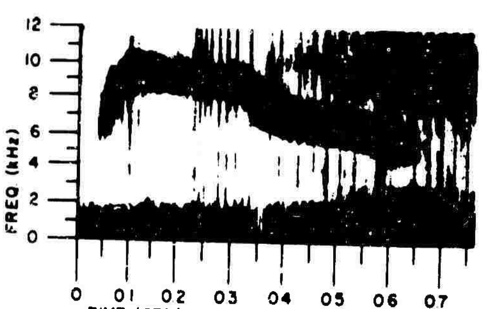

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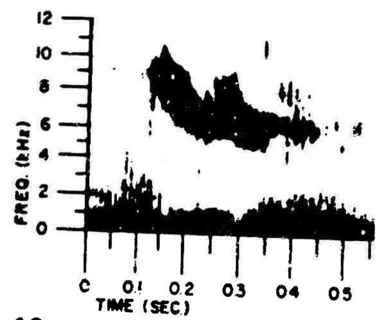

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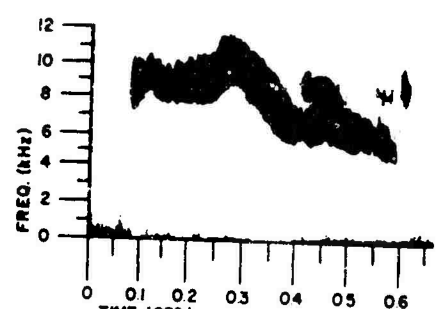

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Figures 15 – 25. Sound spectrograms of whistle emissions by an adult male Pacific whitesided dolphin (MLF 193, Animal Number 2) captive at Marineland of Florida. Sounds recorded in air while the animal was stranded during medication and handling. Effective filter bandwidth in each case 600 Hz. (Photographs courtesy Marineland of Florida)

Figs. 15 - 17. Less than one loop.

Figs. 18 - 20. One loop.

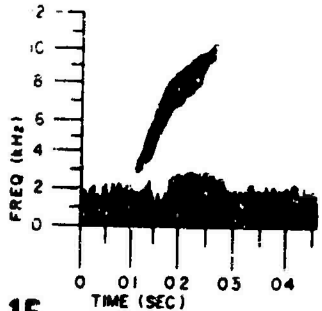
Fig. 21. Two loops.

Fig. 22. Three loops.

Fig. 23. Four loops.

Fig. 24. Five loops.

Fig. 25. Aberrant whistle.



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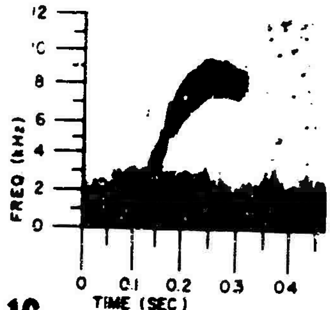

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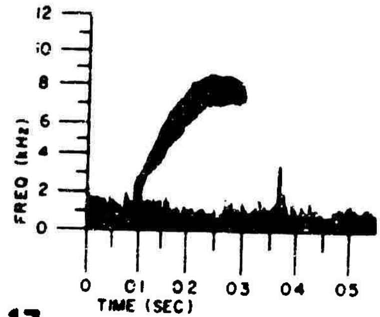

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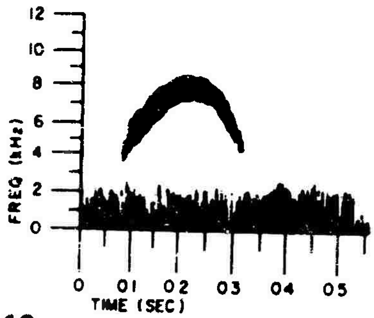

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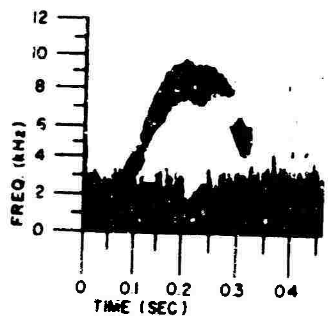

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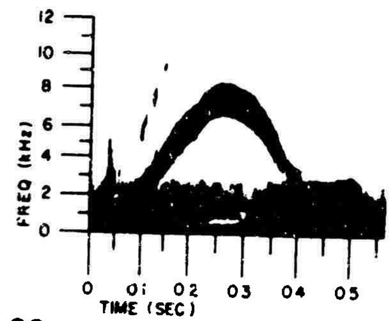

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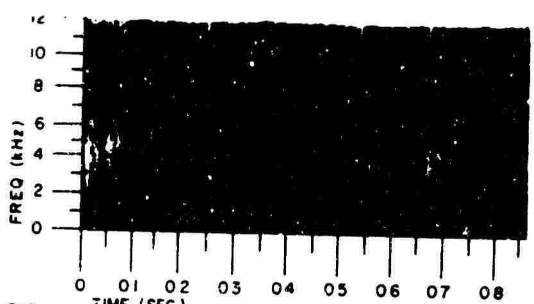

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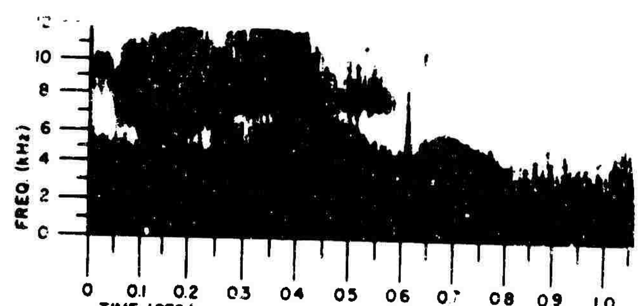

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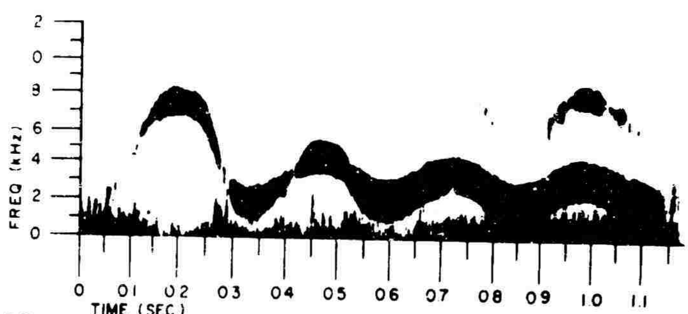

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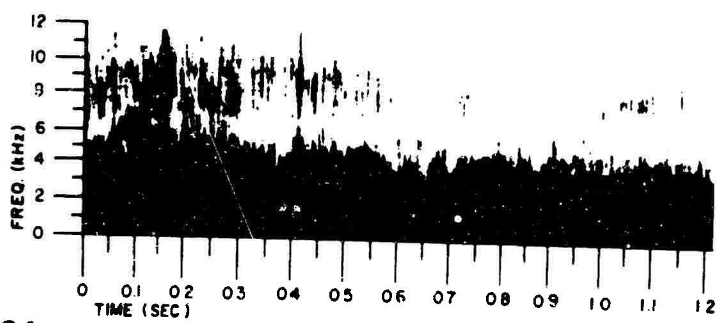

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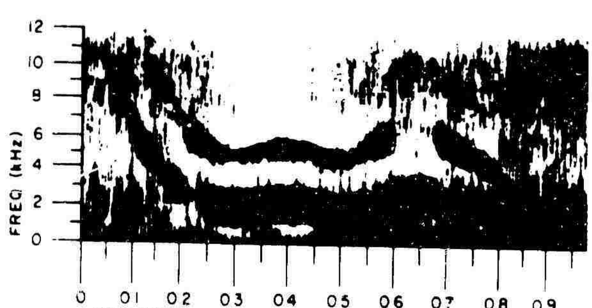

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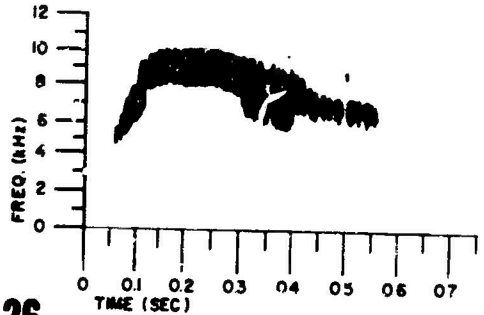
Figures 26 – 27. Sound spectrograms of whistle emissions by an adult-sized female Pacific whitesided dolphin (Animal Number 3) captive at Marineland of the Pacific. Sounds recorded in water under normative conditions. Effective filter bandwidth in each case 600 Hz. (Photographs courtesy Marineland of Florida)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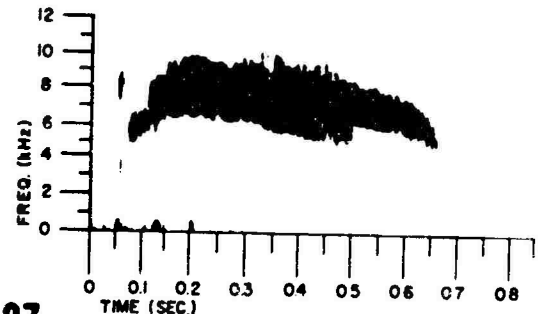
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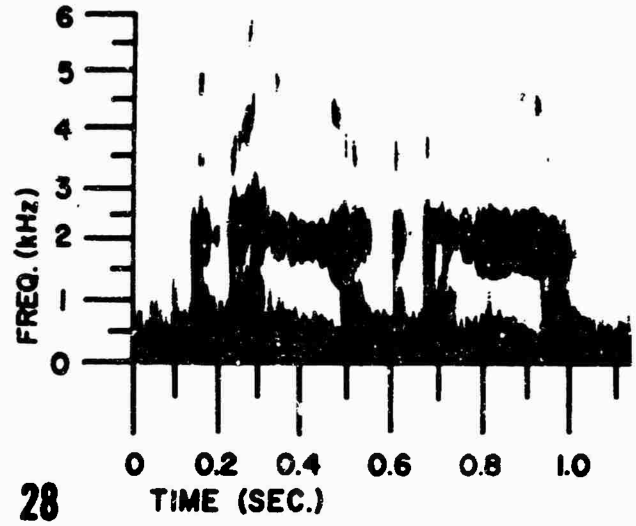
Figures 28 – 30. Sound spectrograms of sound emissions by an adult-sized female Pacific whitesided dolphin (Animal Number 1) captive at Marineland of the Pacific. Sounds emitted in water under normative conditions. (Photographs courtesy Marineland of Florida)

Fig. 28. "Tin horn" sound. Effective filter bandwidth 300 Hz.

Fig. 29. Sound intermediate between "tin horn" and whistle. Effective filter bandwidth 600 Hz.

Fig. 30. Whistle. Effective filter bandwidth 600 Hz.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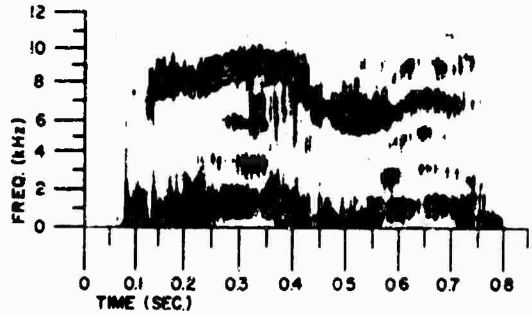
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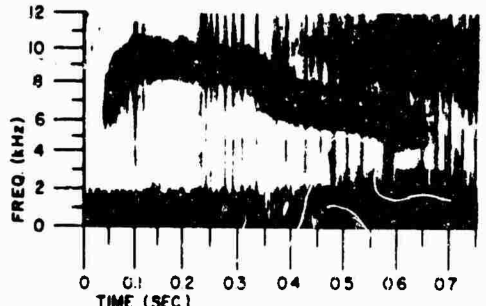
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Table 1. Tape numbers (tapes stored in the Caldwells' files), recording dates, recording conditions and number of whistles analysed for the three Pacific white-sided dolphins used in the present study. (A) recorded in air; (W) recorded in water.

Date Recorded	Tape Number	Conditions and Method	Number of Whistles
Animal number 1			
11/12/66	B-11(1)	Normative (W)	9
12/3/66	B-15(2)	Normative (W)	5
6/4/66	A-38(1)	Normative (W)	34
7/14/66	A-44(1)	Venipuncture (A)	14
Animal number 2			
6/14/67	D-4-A	Medication (A)	38
6/19/68	M-49	Medication; moving (A)	13
7/31/68	M-63	Medication (A)	2
10/23/68	M-76	Medication (A)	2
2/12/69	M-125	Medication (A)	17
Animal number 3			
11/12/66	B-11(1)	Normative (W)	2

Table 2. Analysis of 72 whistles of adult male Pacific whitesided dolphin number 2 (MLF 193).

Type of Whistle	Total Number Each Type	% of Total of Each Type
Less than 1 loop	11	15.3
1 loop	1	1.4
2 loops	16	22.2
3 loops	17	23.6
3½ loops	2	2.8
4 loops	16	22.2
5 loops	5	6.9
5½ loops	2	2.8
Aberrant	2	2.8

Unclassified

Security Classification

DOCUMENT CONTROL DATA - R&D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Los Angeles County Museum of Natural History Foundation 900 Exposition Boulevard, Los Angeles, California 90007	2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP

3. REPORT TITLE

"Statistical evidence for individual signature whistles in Pacific whitesided dolphins, Lagenorhynchus obliquidens"

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13. ABSTRACT

The whistles of three Pacific whitesided dolphins were analysed for signature content. While the whistles of these animals were the least stereotyped of any species studied in this regard to date, the hypothesis of a signature whistle in certain species of dolphins (if not all that whistle) was found to hold. Only two of the animals studied made enough whistles definitelyattributable to the individual to make definitive statements. The few whistles surely emitted by the third animal corroborated the other findings that such a signature whistle exists in this species. The whistle type of sound in one of the individuals studied seemed to grade into a pulsed type of sound referred to in earlier literature as a tin horn sound. Numerous sound spectrograms are used to illustrate the discussion.

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